CORNFIBRE,

AND ITS USES.

A HISTORY OF THE DISCOVERIES AND INVENTIONS

OF

CHEVALIER AUER VON WELSBACH,

L. R. AULIC COUNCILLOR, MEMBER OF THE IMPERIEL ACADEMY OF SCIENCES, DIRECTOR OF THE IMPERIAL PRINTING AND PAPER-MAKING ESTABLISHMENTS, VIENNA, AUSTRIA.

PATENTED IN THE UNITED STATES, APRIL 21st, 1863.

WM. AUFERMANN, 90 BROADWAY, NEW-YORK,

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CORNFIBRE AND ITS USES.

SCARCITY OF RAGS.

The recent discussion in the public press of the proposed reduction of the paper duty has rendered the fact familiar to all newspaper readers, that, for years past, the supply of rags—the raw material from which paper is made—has not been equal to the demand. The sphere of the rag-gatherer has gradually extended from the countries of Southern Europe to the whole of the East, including the East-Indies, China, and Japan, as well as to every part of the American Continent; but even the enlarged field has not yielded a sufficient supply for the growing wants of the manufacturers. In fact, it is impossible that the increase in the supply of rags should keep pace with the enormous increase in the demand for paper. Not only does the feverish activity of our literature, in its varied shapes of daily, weekly, monthly journal, of pamphlet, review, or library volume, call for a supply of *printing*-paper increasing in an almost geometrical ratio; not only do public schools, with their general spread of knowledge among all classes, and our new and more rapid means of communication, with daily mails and cheap postage, foster a facile use of *writing*-

paper, bordering upon waste; not only does the steady advance of all nations in wealth, with its attendant desire for comfort and cleanliness, cause dull white-washed walls to be superseded by ornamental patterns, neatly printed on the ever-ready *wall*-paper, and millions of large and small articles of trade to be carefully packed in *paper boxes* and *paper wrappers*, but, in addition to these all but exhaustive and constantly widening sources of consumption, man's restless ingenuity has recently devised, and is each day discovering, new modes of rendering paper serviceable to his wants and comforts.

Of the thousand and one uses to which paper is nowadays put, undreamt of by our forefathers, and not too well known by those of our generation, it suffices to mention a few of the most heterogeneous. Paper is now extensively manufactured into lining for ladies' bonnets, and soles of boots and shoes; into shirt-collars, cuffs, and bosoms, and roofing for houses, ships, and railroad cars; into gentlemen's hat-bodies, and trails for ladies' dresses; into oil-cloth and trunks; into leather for covering cheap sofas and children's carriages; into wooden furniture, window-shades, awnings, and twine; into moulds for sugar-loaves, and armor for ships of war. It is impossible to say what it will not be manufactured into.

Against the increased demand for these varied purposes we have no set-off in an increased supply. Rags cannot be raised or manufactured *ad libitum*, like any other raw material. The extreme limits to which the gathering of them can be profitably pushed by perseverance and enterprise, are but narrow and quickly reached. Rag-gathering is a pursuit not often followed from choice, and readily abandoned upon very slight temptation. Hence the supply of rags invariably de-

clines as soon as labor finds ready employment, that is, at the very time when the demand increases. As the supply of this valuable raw material cannot be increased at will, a variety of plans have been tried to economize it; all of which can be summed up as attempts more or less successful to convert the paper that has once served its purpose, by being written or printed on, again into pulp, and this again into a fresh sheet of paper of inferior quality. Thus the white and snowy page from original New-England rags, upon which the college youth has so carefully penned his exercise, wanders through a variety of unsavory channels back to the mill from which it came, and issues forth again in due time as a brittle, feeble, dust-colored sheet, on which the lucubrations of some newspaper editor will puzzle the weary eye of the inquiring reader. The unsold or well-preserved newspaper sheet, in its turn, serves the bill-poster in place of white paper, especially for heavily lettered bills posted on the lower copings of walls and against the sidewalks, where the small type of the cutting editorial disappears from view and offends no more. From here the professional rag-picker will, in due time, peel it off, after the paste has been moistened by heavy showers, and send it once more on its endless journey to the mill, whence it returns this time perhaps in the shape of a heavy card, covered thick with a brilliant gloss of white arsenic enamel, on which, at the right season, invitations will be printed, calling the world of fashion to their neighbors' homes. Or again, the paper of our worn-out hats, and shoe-soles, and floor-cloths is made up into fancy *papier-mâché* boxes, inlaid with pearl and gaudy with paint and gold, to hold faint perfumes and pink-colored notes; while the careful housewife scrupulously saves every scrap of waste

paper, and our very soiled linen wanders, not to the washerwoman, but the paper-basket.

But all these petty economies cannot, of course, make up for a radical deficiency in the supply, and hence intelligent manufacturers, all the world over, have, for years past, been searching for substitutes to take the place of rags, and a variety of articles—hemp, manilla, straw, cotton-waste, and bagging, and even wood and cane—have been tried with more or less success, and some of them are now extensively used. But all of these are either in themselves expensive and difficult to work, or are suited only for certain kinds of paper, generally the lowest grades, or else require a large proportion of rags to render them of use.

The main qualities required to make an article available as a substitute for rags, are: a regular and abundant supply at a low price, a fibre that can be reduced to great fineness without destroying its strength, a natural whiteness like that of cotton, or else the faculty of bleaching readily like flax. In order to be abundant, it must, of course, be the product of a plant raised by cultivation; for the supply of articles growing wild is, at all times, irregular and unreliable. In order to be cheap, some part of the plant must be sufficiently valuable for purposes other than paper-making to pay for the cultivation of the whole, and the remainder must not be urgently required for any other manufacture, nor be otherwise in demand. All of these qualities are possessed, in a remarkable degree, by parts of the Indian corn plant, which is raised for its grain or seed—the *corn*, while its husks, stalks, and leaves are not of any actual merchantable value.

INDIAN CORN.

The three main kinds of farinaceous food, which together furnish the largest proportion of sustenance to man, are: wheat, rice, and corn. The first is essentially the food of the Anglo-Saxon, the second of the Hindoo-Malay, the last of the Latin, Spanish-American, and negro races. The wealthier portions of the north of Europe, of South-America below the southern frontier of Peru, (where the climate no longer favors corn-raising,) and the greater part of Australia, live on wheat. Almost all Asia and the Islands of the Pacific subsist on rice. In Europe—Portugal, Spain, the north of Italy, the shores of the Mediterranean, and the eastern provinces of Austria; in Africa—the countries lining the Mediterranean, and the west coast from Sierra Leone to Congo, as well as large interior districts; in Australia—the northern and south-eastern colonies; in Asia—the north-western portion of the Chinese empire, the northern shores of Bengal Bay, and the Philippine Islands, (settled by people of Latin race,) all cultivate corn in immense quantities, and use it as their chief food. But the true home of this valuable and wide-spread cereal (called by the botanists, Zea Mays) is the American continent. Here it is indigenous. From here, in the beginning of the sixteenth century, it was first carried to Europe, and thence gradually spread over the other quarters of the globe. Here it attains its greatest luxuriance and productiveness. In parts of Central America, the plant attains a height of twenty feet, and yields three and four crops a year, each crop producing five and six hundred-fold, in favored districts even eight hundred-fold, and some single plants the almost incredible return of fifteen hundred-fold. Between forty-nine degrees of

northern and forty degrees of southern latitude there is scarcely any climate in which it does not flourish, from the Canada frontier to the tropical Amazon, from the low lands of the Mississippi to the mountain plains of Mexico, and the volcanic valleys of Peru, eight thousand five hundred, and twelve thousand feet above the level of the sea. The production of corn amounted in the United States alone, in 1862, to nearly six hundred millions of bushels,* from an area of over forty thousand square miles, which are under cultivation with it; while it is estimated, that in all countries combined there is a larger area planted with corn than with any one other cereal. The latter statement may appear exaggerated, in view of the overwhelming populations of Asia subsisting mainly on rice; but it must be remembered, that rice in those countries is too precious for any other use

* According to the report of the Bureau of Statistics, Department of Agriculture, in the "Monthly Report of the Condition of the Crops, for September, 1862," the exact amount raised in the loyal States was as follows:

Maine,	1,855,285	Ohio,	71,792,253
New-Hampshire,	1,668,285	Michigan,	15,190,137
Vermont,	1,585,020	Indiana,	92,855,454
Massachusetts,	2,465,215	Illinois,	138,356,135
Rhode Island,	458,912	Missouri,	54,679,118
Connecticut,	2,059,835	Wisconsin,	10,087,053
New-York,	24,073,257	Iowa,	49,340,393
New-Jersey,	10,023,336	Minnesota,	3,983,426
Pennsylvania,	30,721,821	Kansas,	6,814,601
Maryland,	14,444,922	Nebraska Territory,	1,846,785
Delaware,	3,892,337	California,	478,169
Kentucky,	48,032,725		
		Total Bushels,	586,704,474

This enormous total is exclusive of the States then in rebellion, all of which produce corn in large quantities.

but human food, whereas, in America, corn is produced so cheaply and abundantly that it is used for a variety of manufacturing purposes, and is also the main food for cattle and animals of all kinds; while, in some places, it is commonly said to pay for raising only when it can be *walked* to market, in the shape of fat pigs and cattle, and in some years has been burnt by the farmers in place of coal. The husks, stalks, and leaves of this enormous production of corn have never, heretofore, been turned to practical advantage. Here and there small quantities have been used in a wasteful, careless way for fodder and for bedding cattle in winter, or burnt as light fuel, or left to rot on the fields as manure, but by far the greater portion of the supply has been allowed to waste, and no means have been discovered of rendering them valuable as an article of commerce. It is the object of these pages to point out how a large part of what has until now been deemed useless can be made very productive, and, at the same time, an ample supply of raw material obtained for an important branch of industry urgently in want of it.

HISTORY OF THE DISCOVERY.

It may seem to require explanation, why the call for a discovery seemingly so much needed, and yet so simple, should have remained so long unanswered. The reason is to be found in the great distance, both in space, pursuits, and knowledge of one another that separates the corn-grower and the paper manufacturer. Corn growing flourishes in Southern climates mostly, paper making in Northern climates only. The corn-grower generally obtains a sufficient remuneration for his labor by selling his corn, and is not much troubled with his husks; while

the paper manufacturer, if he ever thinks of corn-husks as a substitute for his declining supply of rags, promptly reasons, that the expense of transporting them to his mill would make them cost nearly as much as the rags themselves. Besides, in the Northern parts of the United States, where the paper manufacturer does occasionally come in local contact with the corn-grower, the intense activity of industrial and commercial life, and consequent ample return readily obtained for capital in safe and well-known enterprises, have prevented all such discoveries as required for their prosecution an investment of capital extending over years and of uncertain result. In Austria, the only other country, besides the States, in which corn is raised at any practicable distance from paper-mills, the above circumstances unfavorable to discovery do not exist. On the contrary, a liberal and enlightened government, managing national paper-mills, and deeply anxious to raise the prosperity of its agricultural districts, was not only peculiarly able, but willing to encourage and support the necessary experiments; and it is to this enterprising spirit of the Austrian Government, that the great corn-growing countries of North and South-America will owe the means of hereafter deriving large annual additions to their wealth by giving a commercial value to millions of pounds of produce heretofore wasted.

It was probably the knowledge, that in China large quantities of paper were made from rice-straw, and that the same material had also been successfully employed in Europe, that first led to experimenting with corn-straw. As early as the beginning of last century, two factories for working cornfibre into paper are known to have been in existence in Italy. That country then oc-

cupied a leading position among paper-producers, having been among the first to introduce the manufacture into Europe, as it was among the first to adopt the cultivation of corn. At what time these factories were discontinued, or what led to their suspension, is not known to us, and of the processes they employed we likewise remain in perfect ignorance. In a work published in Ratisbon in 1772, and again in another issued in Cologne in 1838, samples of cornfibre paper are inserted, but without further information. William Cobbett, the English reformer, in his work on the corn plant, states, that he had had some paper made from corn-stalks, which was of very fair quality, and upon which the first sheet of his work was printed. These and various other experiments and partial successes tended to maintain the belief, that the cornfibre was destined ultimately to become a valuable substitute for rags in the manufacture of paper. When, therefore, ten or eleven years ago, a Bohemian gentleman of the name of Moritz Diamant began to agitate the question anew, the Austrian Government was already disposed to give him a favorable hearing; and when, in 1856, he claimed to have discovered a simple process for reducing cornfibre to paper-pulp, (the condition precedent to its actual manufacture into paper,) the Minister of Finance, Baron Bruck, to whom he had submitted his proposition, determined to give his process a trial. The Imperial paper-mills at Schlögelmühle, near Vienna, were selected for the purpose, the necessary machinery was erected, every facility provided, the management was placed in Diamant's own hands, and under his directions large quantities of corn-straw were worked up into paper. But the result was totally unfavorable; the

quality of the paper produced was unsatisfactory, and the cost much higher than that of a similar quality of paper made from rags. After a variety of fresh experiments and the expenditure of further considerable sums of money, the whole project, as far as the Government was concerned, was abandoned.

Mr. Diamant now sought to obtain the assistance of private capitalists, but without success, and in 1859 again made application to the Government for a renewal of the experiments by improved methods. This application was so strongly indorsed by intelligent manufacturers, and the Government itself was so much impressed with the importance of the subject, and with the probability that private enterprise might not be equal to the undertaking, that it consented to have the experiments renewed at its expense. They were begun immediately, at the same mill as before, and were carried on with great activity. In a short time, both writing and printing papers were produced by the improved processes, greatly superior to those made in the former trials, but still far from satisfactory. Unfortunately, also, even this imperfect quality was still much higher in cost than rag-paper, and as it was, therefore, deemed inexpedient to manufacture any large quantity of it, the undertaking was a second time on the point of being abandoned. The improvement in the quality of the new paper was, however, so marked as to warrant the Government in consenting to a further series of experiments, more particularly with a view to reducing the price, and in the confident belief, that if the paper could only be made at a reasonable cost, increasing experience would rapidly improve the quality. The actual cost of manufacturing was not in itself considered excessive; the difficulty lay

rather in the heavy railroad freights on the immense quantities of straw which had to be brought to the factory, and which were worked up into a very small quantity of paper, the percentage of waste being very heavy. It was, therefore, proposed to build a new factory in the very midst of the corn-growing districts, so as to save the whole of the railroad freight. But as this would have involved the abandonment of all the elaborate arrangements at the Schlögelmühle Mills, and a further heavy expenditure for erecting an entirely new establishment elsewhere, the Government did not sanction the proposal. The suggestion then was to organize a rude and simple establishment in the corn districts, where the bulky straw should be reduced to pulp, all useless parts and waste carefully separated, and only the material actually suitable for paper-making sent to the mill, thus saving, of course, the heaviest part of the freight. This suggestion was adopted, and in the spring of 1860 the new supplementary establishment was opened, again under the charge of Mr. Diamant himself. A year's time was allowed him to produce the promised results. But difficulties that seemed inherent in the enterprise itself again led to a complete failure. The separation of the raw material in the manner proposed was found impracticable, the quantities that could be produced were insignificant in comparison with the outlay, the quality inferior, and before the trial year was over, Mr. Diamant, completely discouraged, threw up his appointment and entirely abandoned the enterprise.

But the Government had, by this time, gone too far, and incurred too large an expenditure, to give up so important an undertaking, unless utterly convinced of its impracticability. The entire question was, therefore,

placed for solution in the hands of one of the highest civil officers of the crown, the director of all the Imperial printing and paper-making establishments, Chevalier Auer von Welsbach. This gentleman of practical business habits and high scientific culture set about his task with that thorough systematic research peculiarly characteristic of German men of science. He began by abandoning the indiscriminate use of all the different parts of the corn-plant, and, carefully separating the cobs, leaves, husks, and stalks, submitted them separately to the same series of experiments, the result of which speedily proved the correctness of his judgment. For it was very soon found that the fibre, or material suitable for paper-making, was contained in but small proportions in the cobs, leaves, and stalks, whereas it was abundant and of the very finest quality in the husks, or leaves surrounding the ear. This was at once a result of the first importance, and henceforth the experiments were carried on with steady step until they culminated in a most brilliant success.

Attention was now directed almost exclusively to the husks, and all attempts to develop the possible value of other parts of the corn-plant were for the time abandoned. Before long the mill was in a position to make, from the husks alone, papers of excellent quality, strong, white, and susceptible of the highest finish. But their cost, although far below that of the papers first made, was still too high to admit of the hope that they could ever successfully compete with rag-paper. The question then presented itself with great force to Chevalier Auer von Welsbach: What causes the great cheapness of rag-paper?

The foundation and main substance of all paper is

vegetable fibre. The three kinds of vegetable fibre best known and most commonly in use all the world over, are flax, hemp, and cotton. If these fibres were worked up into paper in their perfect state as first obtained from the plant, they would produce a very much stronger and better paper than is now made, *but it would be many times more costly*. It is now made cheap, because the fibre of the flax, hemp, or cotton *is first used for some other more valuable purpose* which amply repays the cost of its production, and is turned over to the paper-mill only *when no longer serviceable for that other purpose*, when really completely valueless. Furthermore, the wear which the material woven from this fibre undergoes in the process of becoming "a rag," its repeated washing with soap and other alkaline substances while in use, tend to loosen, break, and disintegrate the fibre, to reduce it *partially* to that soft, pulpy state to which it must be *entirely* reduced in the mill before it can be made into paper, thus actually *preparing itself* for the paper-mill, and saving a large amount of expensive labor. These are the causes of the cheapness of rag-paper.

The question then naturally arose: Can the fibre contained in the husks of Indian corn be obtained in such a shape that it may be spun and woven like flax, hemp, or cotton, and made up into some material of value, which, while being used for other purposes, will be reduced by wear to a state similar to that of the rag, and then gradually revert to the paper-mill, as a substitute for, or a supplement to, the insufficient, scarce, and high-priced linen and cotton rags? Persevering experiments answered this question with an emphatic "Yes!"

The direct result of these experiments demonstrated the important fact that the husks of the corn contain a long, straight, strong, flax-like fibre, which can be spun, like flax, into a thread, and the thread, like linen thread, woven into cloth. It only remained to put this result of scientific experiment into a practical shape, and this also was speedily accomplished. A simple and inexpensive process for obtaining the fibre, requiring but slight apparatus and few other aids, was invented, and, by large practical tests, it was soon proved that the fibre could be readily extracted in large quantities, and that good, sound husks would yield fully ten per cent of their weight in fibre fit for spinning. The labors of the inventor were thus crowned by a discovery of extraordinary value. Here was a new fibre, a new raw material, the importance of which it was impossible to calculate, which could be produced, at a trifling expense, from a plant whose extension over the globe exceeds that of cotton tenfold, and of which the very refuse alone is required for the purpose. Millions of tons of corn-husks that heretofore had annually rotted upon the ground were suddenly rendered valuable. A substitute for a variety of raw materials hitherto gathered together from the ends of the world, was unexpectedly found lying at our own doors in untold quantities.

It seems appropriate in this place to quote the words of the inventor. He says: "From the moment when the thought struck me, to first produce the fibre independently, before working it into paper, I knew no peace or rest. The difficulties to be overcome, before the very first imperfect results could be reached, were measureless, and can only be appreciated by those who, like my-

self, have sought discoveries in entirely new directions and with unknown materials. Scarcely a day passed without some new quality, some new peculiarity of the material being made apparent; not a day but what brought new hopes, and scarcely one but brought new disappointments. The history of every discovery is a history of the sufferings of the discoverer, and it is given to but few to imagine even of what sorrows, struggles, anxieties, and despondencies great inventions are brought forth. The hope of benefiting the industrial and agricultural interests of my native country, alone sustained my courage, and I can now look back with satisfaction to those years of labor, for I feel that they have not been in vain."

The process of preparing the fibre was at once patented in all European countries, and in 1863 a similar patent was granted by the United States, to whose citizens the discovery is likely to be of the very highest commercial and agricultural importance.

To any one at all familiar with the delicate and complicated machinery in use for spinning and weaving well-known fibres, or to any one who remembers from the beginning of the Southern rebellion, how a great portion of the cotton machinery of England had to be altered in important particulars to adapt it to the cotton of India, in place of that from our southern States, (although the difference between the two is scarcely to be recognized by the casual observer,) to such a one it is unnecessary to explain why the new material has not been as yet extensively manufactured. Enough, however, has been done by enterprising German manufacturers to show that the cornfibre in strength, softness, elasticity, and endurance of exposure, excels by far all the coarser

fibrous materials now in use. In its present imperfect state it takes rank near hemp, and will furnish an excellent substitute for the coarser kinds of flax and hemp cloths, and will, no doubt, at once supersede all jute, coir, (or cocoa,) and gunny cloth and bagging. To give an idea of the importance of a raw material, suitable even for such ordinary purposes, it may be well to mention that the material used for baling our entire Southern cotton crop is imported from the East-Indies, at an annual expense of nearly two millions of dollars gold; that from the island of Ceylon alone we import annually half a million in value of coir and coir-matting; while in Scotland no less than seventy mills and two thousand hands find profitable employment in manufacturing jute goods, to the value of two millions of pounds sterling per annum. The inventor does not anticipate that cornfibre will ever take the place of flax or cotton, but he does believe that, in the hands of ingenious American manufacturers, it will shortly be carried to a development second only to the two materials named, and will even profitably take the place of flax in its coarser fabrics.*

* In answer to the very natural question concerning price, it is at present only possible to state: in the estimates of costs and profits of an establishment for producing cornfibre on a large scale, (furnished by Chevalier Auer von Welsbach, the inventor, and appended hereto,) the value of the Austrian Centner (one hundred and twenty-three and a half pounds avoirdupois) of the fibre has been taken at sixteen florins, or eight dollars gold, making six and a half cents gold, per pound, and showing at this valuation a large profit to the manufacturer. The cost of the corn-husks has been taken in this calculation at two florins per centner, or about sixteen dollars gold, per ton. These figures are quoted merely to give some idea of the *estimated* cost of the fibre, and to show upon what that estimate is based. But they are not intended as conclusive. It is difficult to name a price at which farmers would

In addition to its value for spinning, the fibre can be advantageously used as a substitute for horse-hair, in stuffing furniture, carriages, and mattresses. It has also been used with great success in place of cotton for making "gun-cotton," and there can be no reasonable doubt that, when once manufactured in quantities, a great many additional uses will be found for it, as its qualities become better known. The time elapsed since the discovery was made has been too short to admit even of much experiment, and the nine years employed in obtaining even this result have taught the necessity of patience. Besides it was not the object of the inventor's researches to discover new fibres for spinning and weaving, but to make cheap white letter and printing paper from corn-stalks, and the development of the cornfibre was only an incidental result of his endeavors. It could not be his

consider themselves sufficiently remunerated for stacking their husks carefully and bringing them to market. But offers have been made to furnish large quantities at sixteen dollars gold, per ton, and there is no doubt that when the value of the husks becomes generally known, they will be saved throughout the country, and will soon become very cheap. Hay, which requires the exclusive use of the land for its culture, and the raising of which is attended with considerable labor and risk, is sold in ordinary times, after paying heavy freights, at twelve to fifteen dollars per ton. Surely the corn-husks, heretofore allowed to rot, ought not to cost one half as much.

It is equally difficult to say what would be the merchantable value of the fibre when brought to market, but we may form some estimate when we know that manilla hemp, with which the cornfibre will probably come into direct competition, is sold in this market at twelve and a half cents per pound, and that the price of coir is eight cents, of jute ten cents, and of the fibre of gunny-cloth about eight or nine cents per pound, all in currency, while the value of the cornfibre is taken in Chevalier Von Auer's estimates at only six and a half cents gold, per pound.

wish, therefore, to immediately pursue his experiments for turning the new fibre to account as a spinning material; on the contrary, he determined to first accomplish his original object.

THE NEW ARTICLE OF FOOD.

In the course of extracting the cornfibre, the husks are submitted to a process of boiling with an alkaline mixture, as a result of which the long fibres are found at the bottom of the boiler in a spongy condition, filled with a glutinous substance, which, on closer examination, proves to be a perfect dough of corn-meal, and is found to contain in a concentrated form all the nourishment, whether for man or beast, originally contained in the husk. This dough can be dried and baked, and furnishes a good, wholesome, sweet bread, especially when mixed with wheat flour. It possesses the peculiarity, that it keeps perfectly sweet for months, although exposed to the air; it will not mould, and excels almost all known vegetable substances in its resistance to decomposition. Mixed with wheat flour, it would probably make the very best material known for shipbread and crackers. Cattle eat it voraciously. Perfectly dry, it makes most beautiful fuel, and in any condition it is invaluable as manure. Of this interesting and useful material, the cornhusks used in the Schlögelmühle mills were found to contain about eleven per cent; it is, however, probable that the richer corn of this continent, especially that from more southern latitudes, will be found to contain a larger percentage, and be correspondingly more profitable. In the government bakeries attached to the Schlögelmühle Mills, this dough is mixed with wheat flour, in the pro-

portion of one to three, and one to five, producing a bread entirely acceptable to the workmen.*

THE NEW PAPER-MAKING MATERIAL.

Although the entire series of experiments which has been related was originally begun for the purpose of procuring a cheap material for paper-making, it was not until two other important discoveries had been made, and only as a direct result from them, that the real object of the inventor was finally accomplished. It has been seen how the fibre, after boiling, comes from the husk filled with the glutinous dough. This dough is squeezed out from between the fibres by powerful hydraulic presses. The fibre then remains in the shape of a bunch of longitudinal threads, connected together by, and interspersed with, a dense mass of short, soft, fluffy film, which, in preparing the fibre for spinning, becomes detached, and is carefully gathered up. In the water in which the husk has been boiled large quantities of this same short fibre are found floating, and are easily obtained by straining. This short film, or fibre, closely resembles the pulp made in a paper-mill from linen and cotton rags, *and is, in fact, the long-sought new material for paper-making, the much-desired substitute for linen and cotton rags.* In thus developing this new material, the result originally aimed at by the inventor has been reached in a perfection almost marvellous. We have seen that the reason why rag-paper is cheap is, that the fibre of flax,

* Curiously enough it is found that a slight admixture of this dough has the effect of totally destroying the bitter taste sometimes noticed in wheat flour, and commonly attributed to the presence of the parasitic growth called "fly."

hemp, or cotton, is first used for some other more valuable purpose, and turned over to the paper-mill only when no longer serviceable for that other purpose. By this new discovery we have not only the corn-fibre ready for use for some other more valuable purpose, to be in due time returned to the paper-mill, after accomplishing its first mission, but we have, *in addition, almost without cost, as mere waste, as the incidental result of producing the material of real value, a large amount of the very best kind of paper stock*, more nearly ready for the paper-vat, than even the well-worn, tattered linen and cotton rags. The quantity of this short fibre, obtained with a very imperfect and rude process of filtering the water in which a large portion of it is found floating, is fully nineteen per cent in weight of the husks used, and the amount of paper which can be made of it is about equal to that made from the same quantity of linen rags. But the quality is, in some respects, far superior.

The papers made from cornfibre are stronger than papers of the same weight made from linen and cotton rags. It has a hardness and firmness of grain exceeding that of the best hand-made English drawing-papers, and rendering it specially adapted for pencil-drawing, water-colors, and stenographic writing, for which latter purpose it is already extensively used. Its durability is greater than that of paper made from any other material whatsoever, and it is not exposed, like parchment, to be destroyed by insects. This renders it peculiarly valuable for documents, records, bank-notes, bonds, etc., and the paper made for these purposes at the Schlögelmühle mills is readily sold at much higher prices than can be obtained for similar kinds made from other material. As tracing-paper it is unsurpassed. By a simple

change in the process of manufacture it can be made extremely transparent without sacrificing any portion of its strength. Experiments recently made show that it is also specially adapted for photographic purposes. In addition to these exceptional and distinctive kinds of paper, all those ordinarily made from linen and cotton rags can be just as well made from cornfibre. It is easily worked, either alone or mixed with rags, into the finest writing and printing papers; readily takes any tint or color, and can be worked almost to as much advantage into stout wrapping-papers of superior quality as into fine note and envelope papers; and the machinery required for manufacturing it is not essentially different from that ordinarily in use in paper-mills working on rags.

ESTIMATED COST AND PRODUCT OF A CORNFIBRE MANUFACTORY.

The following estimates are furnished by Chevalier Auer von Welsbach. They can be relied on as scrupulously correct and truthful.* The figures for a similar establishment in this country would, of course, be quite different, but the general result, it is believed, would be

*In this connection we are permitted to quote the following extracts from a letter addressed by Baron Rothschild to his New-York correspondents, A. Belmont & Co., under date of Vienna, Oct. 14th, 1864:

"I beg to recommend this matter to your kind protection and your warmest support."

"Chevalier von Auer is a distinguished public officer, who has made our Imperial printing establishment what it now is, one of the most magnificent institutions on the Continent. I should feel particularly pleased if this excellent gentleman were to succeed in his object through your kind aid.

(Signed) "S. M. von Rothschild."

the same. The necessary land could probably be purchased in a suitable locality for much less than the Chevalier's estimate, while the building and machinery would certainly not cost more. The raw material, the husks, making 75 per cent of the amount called by him "annual expenses," is expected to cost very much less than one half of the price calculated by him, (see note at page 18,) and the heavy item for coal, etc., would probably also be less, while all other expenses would, no doubt, be treble and quadruple. The value of the fibre for spinning must remain an entirely open question. It is also uncertain whether, in this country of cheap food, prejudice would permit the most profitable use to be made of the glutinous dough; but it will be noted, that the latter is calculated only at the value which it would have for paper-making. Its value as food for animals may be judged from the price of oil-cake, which sells at $50 per ton, or 2½ cents per pound, and which is not believed to contain one half the nourishment of the corn dough. The paper stock, at the present price for rags, would be worth more than twice his estimate of about 4 cents gold, which is lower than the price of good white rags has ever been within the writer's experience.

In the body of the estimates, the American equivalent in gold has been placed in brackets by the side of the foreign currency, taking the Austrian florin at 50 cents gold, although it is actually worth but 45 or 46. In the tables, the amounts are given in the foreign currency and in American gold, in separate columns. The Austrian centner is equal to 123½ American pounds. With these prefatory remarks, we copy the Chevalier's estimates.

COST OF PLANT AND MACHINERY.

In speaking of a Cornfibre Manufactory, we mean an establishment for extracting and preparing for market the three different materials of value contained in the husks and leaves of the corn-plant, namely, cornfibre for spinning, corn-gluten for human or animal food, and corn-pulp for making into paper. Such a manufactory, calculated to work up 100,000 centner (6175 American tons) of husks per annum, would require three or four acres of ground, and a building of three stories with high attic.* The building used for the purpose in the Schögelmühle Mills cost 30,000 florins, ($15,000 gold.) This sum has, therefore, been taken in the estimate. On the ground floor are the steam-boilers and the working boilers; the second floor is arranged for sorting and washing; the third floor for the stock of husks; and the fourth for storage of the finished goods.

The factory requires an unfailing stream of water, or else an inexhaustible well.

The entire plant, machinery, boilers, and all other requisites are estimated at the sum actually paid for those in use in Schlögelmühle, making the total cost of the establishment, including land and building, amount to 107,400 florins, ($53,700 gold.) A factory calculated to produce twice the amount of goods would, of course, cost much less than twice that sum.

ANNUAL EXPENSES.

Raw Material.—The husks have been taken at the price at which they were purchased for the Imperial

*The Chevalier does not give the size of the building. It is believed, however, that 25 by 100 would be ample.

Mills, adding a reasonable amount for freight, on the supposition that the manufactory would be situated near the corn-growing districts. The actual cost to the Austrian Government was much higher, in consequence of the heavy freights they had to pay.* At 2 florins ($1 gold) the centner, (or $16.20 gold per ton,) the outlay for 100,000 centner would be 200,000 florins, or $100,000 gold.

Fuel, Chemicals, and other Material.—All present experience shows the expense for these items in working up 100 centner, (6¼ tons,) to be a little over 39 florins, ($19.62 gold,) or for 100,000 centner, (6175 tons,) 39,000 florins, ($19,500 gold.)

Wages, including every species of labor in the factory, amount to 16 florins ($8 gold) for every 100 centner of husks worked up, or on 100,000 centner, 16,000 florins, ($8000 gold.)†

Interest and Wear and Tear.—As the cost of the plant has been estimated at 107,400 florins, (or $53,700 gold,) the interest at 5 per cent would make 5370 florins,

* Offers have been received from responsible parties to supply any quantity of husks, properly baled, and delivered at a railroad station, at $20 currency, say $15 gold. The Chevalier's estimate is $16.20 gold. But hay, which requires for its culture the exclusive use of the land, and the raising of which is attended with considerable labor and risk, sells in ordinary times, after paying heavy freights, at $12 to $15 gold a ton. It is surely not unreasonable to suppose, that when the husks, *which cost nothing to produce*, are everywhere saved, they can be bought for less than one half the price of hay.

† In spite of the very much higher rate paid for labor in this country, it is supposed that the above estimate would not be much exceeded, as a much more practical arrangement of the factory than the one indicated by Von Welsbach could easily be devised, and many labor-saving machines and contrivances, unknown on the other side, could no doubt be profitably employed here.

(or $2685 gold.) Add to this an annual deduction for wear and tear of further 5 per cent, and we have a total of 10,740 florins, (or $5370 gold.)*

PRODUCTION.

With the machinery now in use in the Imperial paper-mill, 100 centner of husks yield 10 centner spinning fibre, 11 centner corn gluten, and 19 centner pulp; total, 40 centner, or 40 per cent of the raw material, showing a loss or waste of 60 per cent. This waste consists mainly of gluten and fine pulp, and when proper filtering apparatus will have been constructed, a large additional percentage will be saved. No notice has, however, been taken of this increased production in the estimates below.

Spinning Fibre.—As long as the cornfibre, corn-thread, and corn-cloth do not form regular articles of trade, it is difficult to attach any value to this part of the product of the factory; but considering the value of other fibres, and comparing the cornfibre with them, it is thought that the estimate of 16 florins ($8 gold) for a centner is a very moderate one.†

* The rate of interest is, of course, too low. But wear and tear has been allowed on land and buildings, the value of which with us would probably increase instead of diminishing, (due allowance having been made for repairs;) so that the total is probably not much out of the way.

† This would make 6½ cents gold, or (with gold at 130) 8½ cents currency per pound. The present market value of other similar fibres is as follows: Manilla hemp, 12½ cents currency per pound; gunny cloth, (already woven,) 9 *a* 9½ cents currency per pound; jute, 10 cents currency per pound; coir or cocoa-fibre, 8 cents currency per pound. The corn-fibre is certainly more valuable than either of these, except, perhaps, manilla hemp, and it is questionable whether it will not for many purposes excel even the latter.

Corn-Gluten.—For similar reasons, it is difficult to put a price upon this article. In the estimate, it has been taken at what it would be worth for making paper, to which purpose it is also adapted; 3½ florins (or $1.75 gold) per centner (or less than 2 cents currency per pound) is believed to be a low estimate.* 11,000 centner at this price would make 38,500 florins, ($19,250 gold.)

Paper Pulp.—The value of this article is more readily got at than that of the other products of the corn-husk. Its quality is fully equal to that of the best linen rags, and it will make the same quantity of paper that a similar weight of rags will produce. At the lowest market price of 9½ florins (or $4.75 gold) per centner, (or less than 4 cents gold per pound,) the 19,000 centner would be worth 180,500 florins, (or $90,250 gold.)†

Placing all the above figures in tabular form, we find:

COST OF PLANT.

	Austrian Currency.	American Gold.
Land,	Fl. 16,000	$ 8,000
Factory building, 3 stories and attic,	30,000	15,000
Boiler-house, with chimney,	6,000	3,000
2 Boilers, *a* Fl. 4000,	8,000	4,000
5 Working Boilers, *a* Fl. 5000,	25,000	12,500
5 Washing and Bleaching Machines,	6,000	3,000
Steam-Engine, with coupling, etc.,	4,000	2,000
Steam-pipes,	2,000	1,000
2 pumps, *a* Fl. 1200, and 2 hydraulic presses, *a* Fl. 2000,	6,400	3,200
Sundries,	4,000	2,000
Total cost of plant,	Fl. 107,400	$53,700

* Oil-cake, which is not believed to contain one half the nourishment, is sold in large quantities at 2½ cents currency per pound.

† $4.75 gold per centner is less than 4 cents gold per American pound, or, with gold at 130, 5¼ cents currency. Good white rags are now selling at 12 cents currency, and have not for many years been below 6 cents. It does not seem likely that they will ever permanently return to that price.

ANNUAL EXPENSES.

	Austrian Currency.	American Gold.
100,000 centner corn-husks, *a* Fl. 2,	Fl. 200,000	$100,000
Fuel, chemicals, etc., . . .	39,000	19,500
Labor, ...	16,000	8,000
Interest and wear and tear, . .	10,740	5,370
Salaries,*	5,000	2,500
Light, repairs to building, and sundries, ...	3,000	1,500
Total annual expenses,	Fl. 273,740	$136,870

PRODUCTION.

	Austrian Currency.	American Gold.
Fibre, 10,000 centner *a* Fl. 16,	Fl. 160,000	$80,000
Gluten, 11,000 centner *a* Fl. 3½,	38,500	19,250
Paper pulp, 19,000 centner *a* Fl. 9½,	180,500	90,250
Gross product, . .	Fl. 379,000	$189,500
Deduct annual expenses,	273,740	136,870
Net profits, . .	Fl. 105,260	$52,630

I. R. Austrian Consulate General,
New-York, 26 May, 1865.

Wm. Aufermann, Esq.:

Dear Sir: In answer to your note of this morning, I would say, that the high position and great reputation of Chevalier Auer von Welsbach would, as you are well aware, render my endorsement of his statements in his own country entirely superfluous and wholly out of place.

At your request, however, I take pleasure in stating that I am cognizant of the correctness of most of the statements contained in the pamphlet which you have kindly submitted to my inspection.

* This item is, of course, much too low. Treble the amount would probably be more nearly correct.

In case the American Patent should be disposed of, you may state, on my authority, that Chevalier Von Auer has informed me personally that he will furnish all necessary models, drawings, plans, and specifications to the satisfaction of the purchasers, and will afford to any agent sent over by them every facility for becoming acquainted with the practical working of the different inventions, and that he has made arrangements to send out, whenever required, competent men, well skilled in the business, now employed in the Imperial Mills, and that he probably might himself come out to the States to superintend the first operations.

You are at liberty to publish this note.

Yours, very sincerely,

CHARLES F. LOOSEY.

Samples of the different products of the Cornfibre, received by Consul-General Loosey from the Imperial Mills, can be seen at the Office of the Undersigned.

WM. AUFERMANN,

90 Broadway, New-York.